

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, *et al.*,

Plaintiffs,

v.

TYSON FOODS, INC., *et al.*,

Defendants.

Case No. 4:05-cv-00329-GKF-PJC

DECLARATION OF DR. BILLY R. CLAY MS, DVM, DABVT

1. My name is Billy Clay. I am a Veterinary, Environmental and Agronomic Consultant. I hold a Masters of Science degree in agronomy, and a Doctorate in Veterinary Medicine. I am also a Diplomate with the American Board of Veterinary Toxicology.
2. I have been retained by the Defendants in this matter to provide the jury with a characterization of animal production in the IRW, including the number of cattle and poultry in the IRW and the amount of manure they produce.
3. I previously authored and submitted to my client an expert report detailing my work and conclusions in this matter. I understand that this report was served on Plaintiffs on December 1, 2008. I also authored an errata sheet for and provided corrected appendices to my December 1, 2008 report. I understand the errata and corrected appendices were served on Plaintiffs on March 12, 2009. I incorporate that report, errata sheet and corrected appendices herein by reference.
4. If called to testify at trial, I would testify consistent with the opinions expressed in that report, errata sheet and corrected appendices.

I declare under penalty of perjury that the foregoing is true and correct.

Executed 5th June, 2009.


Billy R. Clay, MS, DVM, DABVT

EXPERT REPORT

BY

BILLY R. CLAY MS, DVM, DABVT

FOR

The Defendants in the:

STATE OF OKLAHOMA, ex rel, W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA, and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,

Plaintiff

VS.

TYSON FOODS, INC., TYSON POULTRY, INC., TYSON CHICKEN, INC., COBB-VANTRESS, INC., CAL-MAINE FOODS, INC. CAL-MAINE FARMS, INC., CARGILL, INC., CARGILL TURKEY PRODUCTION, LLC, GEORGE'S, INC., GEORGE'S FARMS, INC., PETERSON FARMS, INC., SIMMONS FOODS, INC. AND WILLOWBROOK FOODS, INC.,

Defendants

CASE NO. 05-CV-0329 GKF-SAJ.

IN THE U.S. DISTRICT COURT, NORTHERN DISTRICT OF OKLAHOMA

November 29, 2008



Billy R. Clay MS, DVM, DABVT

EXPERT REPORT

BILLY R. CLAY MS, DVM, DABVT
Veterinary Toxicologist and Agronomist

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RATE: \$190/hour plus expenses

EXPERT REPORT OF DR. BILLY R. CLAY

I. BACKGROUND

The Illinois River Watershed (IRW) has been a point of contention between the states of Oklahoma and Arkansas since the river was designated as a Scenic River by Oklahoma in 1969. There have been numerous agreements and disagreements since that date--all related to the quality of water flowing into Tenkiller Ferry Reservoir. The focus has been on the "ballooning" population of people and the agricultural activities that exist there. The current issue is focused on the poultry industry as the potential source of impairment for the river while excluding numerous other sources. The claim is that application of poultry litter to farm crops poses a threat due to bacteria and other substances from poultry manure that might enter the river where people play during the summer months and obtain water for household use.

II. OPINIONS

1. Poultry litter like other livestock manures and associated beddings has a long history of safe usage as an important source of fertilizer for human food production.
2. There are a variety of benefits associated with the use of poultry litter fertilizer and its application is highly regulated in the IRW.
3. Approximately 65 % of the land area of the IRW is devoted to farming (agricultural production).
4. Poultry production is one of seven primary farming enterprises that exist in the IRW.
5. Cattle production makes use of most of the land area devoted to farming enterprises. About 75 % of the farms produce beef cattle.
6. Fertilization of pastures and crops within the IRW is dependent upon availability and cost effectiveness of organic (animal manures) and inorganic fertilizer materials.
7. There are numerous sources of animal and human fecal material and its associated bacteria in this watershed.
8. Cattle spend nearly half the time in and near riparian areas while wildlife spend even more time there. The streams serve as the water supply for some of the livestock and most of the wildlife adding to stream-bank erosion and direct deposition of fecal material.
9. Cattle wet manure **production** in the IRW represents about 61 % of the total animal manure while poultry is about 25 % of the total. Cattle manure is deposited directly to the land surface while poultry manure is deposited on an organic matrix in the poultry house and is allowed to undergo drying and fermentation before it is available for land application as fertilizer or export.
10. Fecal bacteria are present in wet (hydrated) manure but die as they are exposed to drying and sunlight.
11. Poultry litter, swine lagoon contents and composted dairy cattle manure contains less dry weight and fecal indicator bacteria than fresh manure. After fermentation and drying poultry manure as litter represents approximately 11 percent of the total produced while cattle manure represents about 77 percent. Fecal *coliform* bacteria content in poultry litter manure is reduced to about 6 percent of the total at the time of harvest while cattle production represents about 90 percent of the total produced at that point.

12. Cattle, horses and wildlife concentrate manure within or near the riparian areas and some manure is deposited directly into streams.
13. Poultry litter produced in the IRW annually has been estimated within a range of 231,000 to 354,000 tons. A middle (near average) estimate is about 295,000 tons.
14. At least 70,000 tons of poultry litter is currently exported annually from the IRW, 23,600 tons are carried over to the next production cycle and 18,000 tons are stored before usage.
15. Of the phosphorus (P) in livestock and wildlife manure produced in the IRW, cattle contribute about 46 percent of the total that is directly deposited on the fields and in the riparian areas while poultry litter available for application represents about 35 percent of that total and it is not applied to the riparian areas.
16. Laws and regulations are in place to govern poultry litter usage as fertilizer. The state has produced no evidence that cattle producers in the IRW have violated the laws and regulations pertaining to the application of poultry litter.
17. There are more than 11,000 property owners in the IRW with 5 acres, or more, but only about 4,500 identify themselves as being engaged in farming. The remaining 6,500 non-farmers have little regulatory oversight relative to the way they manage their properties. Only 1,580 per year have submitted soil samples for assay over the past three years.
18. Confinement poultry businesses are highly regulated by the EPA, FDA and USDA with additional state oversight. For EPA purposes they are identified as AFOs (animal feeding operations) or CAFO's (confined animal feeding operations).
19. There is no evidence that because of the use of antibiotics in poultry production there are concomitantly resistant pathogenic bacteria in the waters of the IRW.
20. The presence of steroid hormones in surface waters in the IRW in parts per billion or trillion concentrations does not suggest that poultry are the source. Hormones are not used as growth promotants in poultry production and all animals, birds, and humans produce and excrete hormones.

growing seasons (Zhang 2002, Mullins 2002, Mitchell 1995, Zublena 1997, Vest 2004). The added water holding capacity allows crop plants to survive during periods of low rainfall and flourish during periods of adequate rainfall. The responsive growth of vegetation serves well to minimize erosion of surface soils.

Commercial inorganic fertilizers tend to be acidifying to soils. This is an undesirable trait in soils typical of the IRW. Those soils are acid prone and require the addition of lime periodically for maximum production. Poultry litter does not contribute in the same way to the acidity and it provides the additional intrinsic calcium and magnesium to further aid in acid neutralization (Zhang 1998). Likewise, poultry litter offers less soluble phosphorus for transport during excessive rainfall events (Edwards et al. 1994, Franklin et al. 2005 and Gaudreau et al. 2002).

In a ten-year study conducted by the US Department of Agriculture-Agricultural Research Service (Sainju 2007) the organic matrix of poultry litter increased soil carbon storage and microbial biomass and activity compared to inorganic fertilization. The advantage existed regardless of the cropping system (tilled with litter vs. no-till with litter applied to the surface). The conclusion was that carbon becomes sequestered in the soil surface which helps to offset atmospheric carbon dioxide and improve soil and environmental quality. For all the reasons cited above poultry litter serves as a valuable soil amendment as well as fertilizer source.

The increased demand for organic and/or natural food products has added another dimension of value to poultry and other farm animal manures. Products that carry the organic label must be grown in or on soils using fertilizers from an organic source. This market offers another opportunity for the small farming enterprise to remain profitable. Several organic food production farms exist in the region of the IRW where beef, vegetable, fruit and other farms are in operation (Kerr Center 2006 and Organic Resource Guide 2006).

AGRICULTURAL PRACTICES IN THE IRW (Opinions 3 through 8)

The IRW consists of approximately 1.1 million acres of land most of which is used for agricultural purposes. Using the 2002 National Agricultural Statistics Service (NASS) census data provided at the county and zip code levels, the farm acres were calculated to be 698,525- about 65 percent of the total. Four thousand four hundred eight-two farms reported for that year (Appendix A, Table A-B and Appendix B). Approximately, 6,525 additional property owners of 5 acres, or greater, were not included in that summary and did not report the use of their acreage to NASS (Appendix I). The bulk of the land on the reported farms is devoted to cattle production (565,000 acres). Approximately 199,000 cattle were present in the watershed at the time of the 2002 census. Of that total 10,829 were

dairy cattle. Hog, sheep, horse and miscellaneous animal and crop farms also exist. In addition, at least 3 commercial plant nurseries exist in the IRW.

Poultry farms are in higher concentration on the Arkansas side of the watershed (463 versus 140 on the Oklahoma side) while farm acreage is more closely divided with 53.3 percent in AR and 46.7 in OK. The predominant bird type produced is broilers with layers, breeders and turkeys following in that order. The average farm has approximately 3 houses in active production for a total of 1,809 houses (Appendix B, OCC 1999 and 2007). Litter from the houses serves as an important source of fertilizer for the farms in the IRW as well as those outside the watershed (U. of AR and OSU Cooperative Extension Ser.). The Oklahoma Conservation Commission (OCC) report dated September 2007 showed litter removal was fairly consistent on a monthly basis throughout much of the year with the higher amounts June through November and lower amounts December through May.

The bulk of the farm land is planted to permanent pasture or hay (334,228 acres). In addition there are 157,048 acres in which forage is grown for cattle (mostly no-till) and 74,368 acres of woodlands that are used as pasture. Approximately, 2,500 acres are devoted to the production of wheat, corn and soybeans. Those proportions are shown below:

<u>Crop/pasture</u>	<u>Acres</u>
Permanent pasture/cattle	184,411
Hay/harvested forage	149,817
Forage for grazing	157,048
Woodland pastures	74,368
Soybeans	1,960
Corn	354
Wheat	206
Total	568,164

At least 494,000 acres of farm land shown above is readily available for equipment access for farming. There is an additional 130,000 acres (mostly in small tracts) devoted to truck farming, nurseries, orchards, poultry houses, horses, swine, sheep and goats and other specialty farming. Some of that acreage would also be accessible to farm equipment.

Beef cattle production in the IRW involves a cow/calf year around system in which the primary product is the produced calf that is marketed in the fall of the year. At the time of the census (January) the cattle herd consists of brood cows, bulls, replacement heifers, carried-over calf crop (including fall calves and dairy calves) and purchased cattle. From February to November the current-year calf crop is produced and sold. There are a few fall calving producers but they are in the minority (county agents and area specialists).

Permanent pastures and most of the hay include bermudagrass and fescue. Seeded forages include cool season grasses (wheat, rye, ryegrass, etc) and summer forages such as sudangrass, millet and others. Most of the permanent pastures are over-seeded with legumes such as clovers (cool season) and lespedezas (warm season). Hay is harvested from all of the forages mentioned. The 47 inches of annual rainfall provide adequate moisture for both the cool and warm season forages to produce maximally if the other required nutrients are available (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and micronutrients). The other nutrients are provided in the form of animal manures and/or inorganic fertilizers. Poultry litter, dairy manure (partially composted) and swine lagoon effluent include the bulk of animal manures (organic) applied while urea, anhydrous ammonia, ammonium nitrate and mixed analysis fertilizers represent the inorganic fertilizers (Appendix A and E). The cool season forages benefit most from fertilization in the late summer to fall while the warm season forages benefit more from fertilization during the spring. Rainfall is fairly evenly distributed during the months of March through December at about 3.77 inches per month with lower amounts during January and February as shown below:

Historical Average Rainfall in inches at Three Gauging Stations in the IRW*

Station	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Tahlequah	2.38	2.44	4.15	4.08	5.66	5.19	3.48	3.23	5.35	4.33	4.65	3.20
Siloam Spr.	2.27	2.09	4.32	4.31	5.20	4.84	3.54	3.35	5.05	3.68	4.82	3.42
Prairie Grove	2.14	2.41	4.17	4.33	5.06	5.26	3.14	3.00	4.83	3.74	4.74	3.20
Average	2.26	2.31	4.21	4.24	5.31	5.10	3.39	3.19	5.08	3.92	4.74	3.27

*www.weather.com 50-year average

Because most of the pastures and forages exist as permanent or no-till, most of the fertilizers are applied to the surface. Nutrient applications are governed by the laws set forth in the respective states and the nutrient management plans for each property. Fifty (ephemeral streams) to one hundred-foot (permanent streams) buffer zones exist where application is prohibited in the vicinity of streams, buildings, wells, sinkholes, etc. Where vegetative filter strips are installed the buffer zone may be reduced to 30 feet. Likewise, application is limited or prohibited in areas of excessive slope, shallow-rocky soils, frozen, saturated or flood-prone ground or during times of anticipated precipitation (Oklahoma statutes Title 2 and Arkansas statutes Title XXII).

The grazing cycle of beef cattle is 9 to 10 months with hay and/or supplemental protein provided during the winter months (3 to 4). Salt and mineral mixes are provided free-choice continuously. Pastures are situated such that most cattle have access to riparian areas, flowing and/or non-flowing (ephemeral) streams (OCC 1999). In many cases the flowing streams serve as the permanent water supply while in others farm ponds serve as the source of water (OCC 1999, personal observation and Appendix K).

Cattle spend 8 to 12 hours per day grazing depending on the available forage (Funston 1991, Gregorini 2006, Burns 2002). During the spring and fall months they spend approximately 8 hours, while in the summer about 12 hours. During the winter most of the cattle are fed hay. Cattle may graze 12, or more, hours during that time if forage is available. When cattle are not grazing, they are staying in the loafing area which is usually the riparian area or near water. In the spring, summer and fall they seek shade which is generally in the riparian areas (OCC 1999). While loafing they are ruminating and defecating. The average beef cow defecates 12 times per day at about 5 pounds per defecation (Larsen 1995). Since cattle may spend up to 16 hours in the loafing area or near hay feeding areas, there tends to be an accumulation of fecal material in those areas along with erosion of stream banks (Mosely 1998, Davies 2004 and Boles 1995). The Wadeable Streams Assessment (EPA 841-B-06-002) shows riparian disturbance within the IRW at 77 % (medium to highly disturbed rating).

Dairy cattle are maintained in a similar pasture setting as beef cattle but most have available more annual seeded forages. The lactating cows (2/3 of the adult herd) are taken to the milk barn at least 2 times per day where they wait in line for milking. During the wait period defecation occurs, as well as, during the roughage feeding period post milking. That manure is stacked and applied to the land 2 to 3 times per year. Between milking periods the cows graze or loaf in the riparian areas as do beef cows. The dry cows (non-lactating) and heifers are kept on separate pastures from lactating and are treated much like beef cattle.

Swine are reared in total confinement buildings and the manure and urine along with excess water and spilled feed is collected in a lagoon. The contents of the lagoon undergo both aerobic and anaerobic fermentation resulting in loss of some of the solid components as gases. The microbial population changes drastically to meet the available oxygen. The lagoon effluent is spread on the pastures at least 2 times per year. Both farrow-to-finish and grow/finish facilities exist in the IRW. The 2002 census data showed that approximately 165,976 swine were present or marketed during that year (Appendix A, Table A-B).

Approximately 1,400 farms reported more than 8,000 horses in inventory (Appendix A, Table A-B). Some of those farms also have cattle. Horses are generally left to graze freely on pastures similar to cattle pastures and loaf as they choose-near shade and water. In some instances horses are kept in dry-lot settings where the loafing occurs in the shade of a barn. The accumulated manure and bedding in those cases is applied to the pastures as fertilizer. The latter case represents the minority (personal interviews). Horses do not always get reported since many owners of small acreages often have horses but do not recognize them as farm animals. The estimate above is considered conservative for the IRW.

Sheep and lambs reported were on 78 farms. About 1,900 were recorded in the IRW (Appendix A, Table A-B). Sheep pastures are more likely to have legumes as a dominant plant. The sheep are housed in the evenings and during the

lambling period to avoid predator attacks. Manure accumulates in the holding areas where it is ultimately collected and spread on the pastures.

Many IRW wildlife species are found on the farms but they tend to spend a disproportionate amount of time in the riparian areas. Deer and wild turkeys forage on pastures and crops near the riparian areas then loaf in the more secluded wooded areas. Using harvest data the whitetail deer population in the IRW is estimated to be 29,400 and wild turkeys at 3,564. Wild geese and ducks visit the watershed during 5 months of the year. Head-day estimates were made on the basis of refuge and central flyway populations-128,000 goose days and 167,900 duck days were estimated (Appendix A, Table A-D). Numerous other wildlife species exist in or visit the IRW (Appendix J).

Nurseries and truck farming operations require liberal amounts of added nutrients for sustained production. Most of those facilities are on the better soil types near the streams where sedimentation has occurred to produce deeper soil layers with more silt and organic material. Irrigation is also required as needed resulting in more potential run-off during rain events.

Bacteria and Nutrient Access to Streams (Opinions 9 through 12)

All production animals, farming enterprises, human waste disposal, human activity, wildlife and numerous other sources contribute nutrients and/or bacteria to the IRW which may, or may not, contribute similarly to the streams and lakes. Fecal bacteria are produced in abundance by all animal species and reside in the wet manure until such time that they may be destroyed or transported via rain water or by direct application to flowing streams (Davies-Colley 2004, Larsen 2005, Soupier et al. 2003, Hall 2007, Gray 1983 and Mundt 1962). As animal manures dry and/or become exposed to sunlight the bacterial load diminishes resulting in less available bacteria for transport (Fujoika 1982, Sinton 2007, Meays 2005, Wang 2004, Almashriq 2008 and Berrang 2005).

Beef cattle, dairy cattle, horses and wildlife have access to streams offering the opportunity for direct deposit of manure while poultry and swine do not have direct access. In the case of poultry some of the manure is applied (indirectly) to the agricultural properties at specific times during the plant production year **but not in the riparian areas.**

Total tons of wet manure, pounds of nutrients and *fecal coliforms* produced annually by livestock and some wildlife in the IRW are shown in Tables A-D and A-E of Appendix A. The wet tons and relative percentages of manure and *fecal coliforms* **produced** for each class of livestock and wildlife is shown below:

	Wet Manure Produced		Fecal <i>Coliform</i> X 10 ¹⁰ _{cfu/100ml}	
	%	Tons	%	No.
Beef Cattle	56.10	1,870,847	80.06	838,655,521
Poultry	25.18	839,773	10.62	111,263,259
Swine	10.87	362,331	6.59	69,011,557
Milk Cows	4.63	154,296	2.47	25,835,666
Horses and Ponies	2.52	83,892	0.01	138,175
Whitetail Deer	0.64	21,421	0.05	535,528
Sheep and Lambs	0.04	1,409	0.13	1,408,694
Wild Turkeys	0.01	459	0.001	12,098
Geese	0.001	24	0.060	629,790
Ducks	0.001	18	0.004	40,800

Poultry, swine and some of dairy cattle manure is allowed to undergo fermentation (composting) and/or drying before it is applied to land (Ag Waste Management Handbook). Those processes alter the bacterial populations and weight for each. In the case of poultry, the manure is dried from 75 percent moisture to about 25 percent and some fermentation takes place as the litter is layered in the houses after each flock (Kelley 1994, Lu 2003 and Lovanh 2007). Likewise, litter with manure that is stored may undergo additional fermentation due to composting (Jeffrey 2001). Dairy manure produced near the milk barn is stacked where composting takes place. Swine manure in lagoons undergoes aerobic and anaerobic fermentation. Some of these manures are applied to the IRW at various times during the year (poultry-after de-caking in some cases and at total clean-out of the house, swine-pump out of lagoons one to two times per year and dairy cattle-two to three times per year).

The relative percentages of “wet manure” and *fecal coliforms* that are **deposited or available for application** would therefore be adjusted accordingly (Table A-A, Appendix A):

	Wet Manure Deposited or Available for Application		Fecal <i>Coliforms</i> Deposited or Available for Application	
	%	Tons	%	No. X 10 ¹⁰ _{cfu/100ml}
Beef Cattle	72.41	1,870,847	87.99	838,655,521
Poultry*	11.42	295,114	5.84	55,631,629
Swine*	7.01	181,155	3.62	34,505,778
Milk Cows*	5.01	129,347	2.26	21,572,782
Horses	3.25	83,892	0.01	138,175
Whitetail Deer	0.83	21,421	0.06	535,528
Sheep and Lambs	0.05	1,409	0.15	1,408,694
Wild Turkeys	0.02	459	0.00	12,098
Geese and Ducks	0.00	43	0.07	670,580

*Some, or all, available for manual application as fertilizer. Poultry manure is shown as litter (24 % moisture for broiler, 34 % for turkey and 50 % for layers.)

The manure applied to agricultural fields after being harvested from respective poultry, swine or dairy cattle operations is spread with an applicator such that individual particles are further exposed to drying and sunlight thus further reducing the viable bacterial load. Poultry litter applied at the rate of two tons (4,000 pounds) per acre (43,560 square feet) would result in the application rate of 1.47 ounces per square foot.

Studies on bacterial survival after exposure to drying and sunlight have shown the depletion rate of various bacteria. Exposure to sunlight on membrane surfaces resulted in inactivation of 90 % of *fecal coliforms* within 15 minutes (Fujioka 1982). *Fecal streptococci (enterococci)* were likewise inactivated but at a slower rate. Harwood (2008) stated in The Preliminary Injunction testimony that bacteria exposed to direct sunlight would be killed within 2 hours.

A study involving beef cattle fecal pats showed that drying influenced the survival of bacteria but in most cases some of the bacteria were protected from sun due to crusting on the surface of the pat (Sinton 2007). The rate of depletion (by 90 %) was in the following order: *Campylobacter jejuni* (6.2 days), fecal *streptococci* (35 days), *Salmonella enterica* (38 days), *E. coli* (48 days) and *enterococci* (56 days).

Water samples collected (by the Oklahoma Department of Environmental Quality and plaintiff's consultants) from streams and other waters within the IRW were identified as having fecal indicator bacteria present. Due to the low relative number, degradation of bacteria in litter after drying and sunlight exposure and placement away from the riparian areas, poultry litter is an unlikely source of bacteria in streams within the IRW. To the contrary, proximity placement of manure near riparian areas by grazing animals and longevity of survival of bacteria in fecal pats makes for a more probable source.

Plaintiff's consultant Teaf has made calculation of *fecal coliform* production in the IRW. Those calculations were compared to that of Clay. Teaf's calculation methods were not clear but it appears that the calculations for livestock present in the IRW has under estimated cattle and over estimated poultry. His cattle calculations do not take into account all cattle present plus he has divided his estimate by 2. The comparison of animals in the IRW and relative percentage of *fecal coliforms* (FC) is shown:

	Teaf		Clay	
	<u>Number</u>	<u>FC/day (%)</u>	<u>Number</u>	<u>FC/day (%)</u>
Cattle	49,228	44.38	199,584	82.62
All Poultry	36.2 MM	41.09	150.8 MM	10.63
All Other LS	162,345	14.53	176,098	6.74

Plaintiff's consultants Engel, Alexander and Smith have calculated what they call a mass balance for phosphorus (P) in the IRW. In their estimates they focus on manure and other sources of P produced with the implication that all phosphorus produced winds up in the IRW with ultimate direct access to the streams and/or lakes. They do not account for livestock products sold other than beef calves. Likewise, they do not account for all crops or produce sold.

Their "mass balance" does not determine the fate and transport of P within the watershed. Because cattle, horses and wildlife have direct access to streams and/or riparian areas, the distribution of manure for those species tends to be more concentrated near the stream's edge or in the streams thus influencing the fate and transport of P in the IRW (OCC 1999). Poultry manure is applied outside the riparian areas. Estimates for cattle, horses and wildlife were based on estimates of sub-watersheds used by the Oklahoma Conservation Commission and other sources. Seventy-nine percent of the beef cattle and horses and 37 percent of the dairy cattle have access to the riparian areas (illustrated in Appendix K). The estimated manure that is deposited directly in the streams or in the riparian areas is shown in Appendix F. Approximately 28,800 tons of manure is deposited directly in the streams annually with an additional 975,000 tons deposited in the riparian areas (mostly from cattle). Approximately 40 percent of the manure and *fecal coliforms* produced by grazing animals and wildlife is deposited within the riparian areas. Livestock and wildlife also contribute to the erosion of the stream banks and riparian areas further influencing the transport of P along with other nutrients and bacteria into streams.

Engel has estimated that cattle contribute 6 percent of the total phosphorus entering the water bodies. He made those calculations through identification of pastures with GIS and using pasture sizes from ODAFF records. His estimates of total cattle using 2002 census data are similar to that calculated by Clay but he assumes only 55% of cattle have access to streams (Clay estimate is 79 %). However pasture size from ODAFF represents pastures that required a nutrient management plan for poultry litter application, typically 20 to 30 acres in size. Not all pastures have an annual measurement. For the years of 2005 through 2007 there was an average annual testing of 618 pastures in Oklahoma and 962 in Arkansas but there are nearly 3,500 cattle farms with multiple pastures for each farm. Likewise, the 585,000 acres of beef cattle farms includes at least 74,000 acres of woodland pasture which would not show up in the GIS survey as open area. In Appendix K the dendritic drainage pattern illustrating 1st and 2nd order streams within the IRW shows that there are few tracts of 160 acres, or greater that do not have a stream with its riparian area. Many of those would have 3rd order tributaries, mostly ephemeral, but cattle manure deposited there is more accessible for rainfall runoff into the perennial streams. Likewise it is important to note that cattle in these pastures tend to reside there year around offering long-term accumulative capacity. Regardless of where the phosphorus comes from originally, cattle tend to transport it toward the streams due to their tendency to loaf in shaded areas and or near water. Of the livestock and wildlife present in the

watershed cattle excrete approximately 50 percent of the phosphorus (3,506 tons) with about 44 percent (1,500 tons) of that placed in or near the ephemeral and /or flowing streams where it has direct access during rainfall events. Obviously, not all of that will appear as measured P in the streams leading to lake Tenkiller but a considerably greater quantity than that estimated by Engel is likely to show up there. His estimate of 6 percent is based on studies in dairy cattle in New York state and beef cattle in the foothills of Colorado. Neither are representative of the weather and/or environmental conditions of the IRW. Loafing near shade and water is a more common occurrence with beef cattle in the IRW (especially those that graze on endophyte-infected fescue). In the beef cattle study referred to by Engel (Gary 1983) 8 percent of the fecal matter was observed to have been deposited directly into the streams—Engel stated that 8 percent was deposited in or within 10 meters and he made his calculations on that basis. With 8 percent of the fecal matter and P deposited directly into the streams using his 55% with direct access to streams, the amount of P placed in IRW streams would be 308,000 pounds (3,506 T of P X .55 X .08 X 2,000 lbs/T). This would be 60 % of the annual total measured (308,000 lbs / 500,000 lbs X 100) as reported by Engel. In the OCC Conservation Basin Management Plan Haraughty stated that “cattle act almost as a point source, depositing nutrients directly in the streams”.

Poultry Litter Utilization in the IRW (Opinions 13 through 17)

Annual poultry litter production in the IRW has been estimated by the plaintiff’s consultants to be 354,000 tons (Engel and Fisher 2008). Dr. Dan Storm in his report to the Oklahoma Department of Environmental Quality in 2003 and 2006 estimated the production at 231,000 tons. The actual production is calculated to be somewhere in between those estimates.

Poultry litter contains the animal manure plus (or minus) wood shavings with all at about 25 % moisture (20 to 40 %). Defendants have provided a list of their active poultry houses (1,810) shown in Appendix I and BMPs, Inc. has provided the average amount of litter harvested from each broiler house where BMPs, Inc. collected it for export from the IRW in 2006 and 2007 (190 tons which includes de-cake material at 35% moisture—when all is adjusted to 25 % moisture = 170 tons). Using those calculations the total production would be 307,700 tons if all litter produced were assumed to have come from broiler houses. Using the Poultry Waste Management Handbook (NRAES-132) and 2002 data, the estimate is 312,033 tons.

From the 2002 census calculations using zip code data there were 603 poultry farms identified in the IRW (Appendix B). Using an average number of houses of 3 per farm (OCC Haraughty 1999, and OCC 2007) the total houses calculate to 1,809- a number very similar to that reported by defendants. The actual estimates based on 2002 agricultural census with adjustments for fermentation and drying

reveals that litter potentially available for application in the IRW is about 295,000 tons (Table A-A, Appendix A). If that is adjusted for a confirmed amount of litter exported annually (Herron 2007 and 2008) the final amount available for application, carry-over or storage is about 225,000 tons. Using information obtained from Fisk 2004-2008 the amount of litter carried over into the 2nd year before a complete clean-out is estimated to be 8.0 percent (23,600 tons). The amount stored is estimated at 6.1 percent (18,000 tons). The annual litter production, carry-over, stored and export estimates are summarized below in tons:

Engel/Fisher	354,000
Storm	231,000
Herron/Clay	307,700
NRAES-132/Clay	312,033
Clay 2002 Census	295,114
Carry-over	23,600
Stored	18,000
BMPs Export	70,000

From the perspective of manure **nutrients available for deposit or potential application to agricultural land**, the 2002 census data was used for calculations and is shown below in tons:

	Dry Mass	%	Nitrogen	Phosphorus ¹	Potassium
Beef Cattle	217,018	50.1	10,967	3,337	6,774
Poultry (litter) *	157,423**	36.4**	4,808**	2,411**	3,024**
Hogs and Pigs*	18,116	4.2	1,032	776	1,251
Milk Cows*	16,168	3.7	636	169	520
Horses and Ponies	18,456	4.3	494	117	411
Whitetail Deer	5,355	1.2	241	38	161
Sheep and Lambs	352	0.1	15	3	11
Wild Turkeys	117	0.03	6	2	2
Wild Geese and Ducks	12	0.00	.5	.2	.1

*Some, or all, is collected and manually applied. Poultry manure is applied as litter minus that exported but all other numbers represent manure.

**Based on Clay estimates but a range of values exist for each.

¹Where phosphorus is used in this report it does not refer to elemental P in practical application. In soil, plant and animal life processes P exists in various oxygenated forms as in phosphate or orthophosphate.

Nutrient source of fertilizer for each of the farming enterprises is different. Wherever possible cattle enterprises use animal manures and/or supplement it with commercial inorganic fertilizer (Appendix E). Until recent years they were advised by their respective State Cooperative Extension Service to use animal manures based on nitrogen (N) content in that most soils have a large capacity to store the less mobile nutrients (P and K). As prevailing concern developed

Appendix B

2002 Agricultural Census data presented by Zip Codes in Counties of Arkansas and Oklahoma in the IRW

Table BA: Arkansas study area 2002 zip code census data showing county zip code and study area data.

and

Table BO: Oklahoma study area 2002 zip code census data showing county zip code and study area data.

Table BA: Arkansas study area 2002 zip code census data showing county zip code and study area data

Zip Code	Benton County														Benton County	
	72704	72712	72716	72718	72719	72722	72734	72745	72756	72757	72758	72761	72762	72764		
	0.57%	100.00%	100.00%	100.00%	100.00%	100.00%	99.84%	100.00%	99.30%	100.00%	100.00%	99.29%	12.18%	7.70%		
Percent in County	100.00%	75.00%	100.00%	100.00%	100.00%	25.00%	100.00%	50.00%	25.00%	100.00%	50.00%	100.00%	100.00%	25.00%	Study Area	
Percent Relevant to Study Area	100.00%	75.00%	100.00%	100.00%	100.00%	25.00%	100.00%	50.00%	25.00%	100.00%	50.00%	100.00%	100.00%	25.00%	Total	
Farms by size , All farms	1.2882	249	0	22	62	40.25	309.504	82.5	49.1535	11	37.5	299.8558	36.54	4.71625	1,205	
Farms by size , 1 to 49 acres	0.6441	113.25	0	11	31	14.75	125.7984	49.5	25.56975	5	21	120.1409	19.1226	2.31	539	
Farms by size , 50 to 999 acres	0.6327	130.5	0	11	31	24.75	179.712	33	23.08725	6	15	174.7504	16.8084	2.29075	649	
Farms by size , 1,000 acres or more	*	5.25	0		*	*	*	*	*	*	*	4.9645	0.609	0.1155	11	
Value of all agricultural products sold , Total farms	1.2882	249	0	22	62	40.25	309.504	82.5	49.1535	11	37.5	299.8558	36.54	4.71625	1,205	
Value of all agricultural products sold , Less than \$50,000 (farms)	1.1229	203.25	0	20	46	24.75	210.6624	69.5	43.44375	11	32.5	218.438	30.2064	3.696	915	
Value of all agricultural products sold , \$50,000 to \$249,999 (farms)	0.0684	16.5	0		5	4.75	29.952	6	1.24125		3	29.787	2.1924	0.2695	99	
Value of all agricultural products sold , \$250,000 or more (farms)	0.0969	29.25	0 *		11	10.75	68.8896	7	4.4685	*		51.6308	4.1412	0.75075	188	
Value of all crops sold, including nursery and greenhouse , Total farms	0.2907	57.75	0		5	5	6.25	53.9136	12.5	8.4405 *		7.5	68.5101	4.6284	0.6545	230
Value of all crops sold, including nursery and greenhouse , Less than \$50,000 (farms)	0.2793	54	0		5	5	5.75	51.9168	10.5	8.19225 *		7.5	65.5314	4.3848	0.59675	219
Value of all crops sold, including nursery and greenhouse , \$50,000 to \$249,999 (farms)	*	*	0		*	*	*	*	*	*	*	*	*	*	0	
Value of sales grains, oilseeds, dry beans and dry peas , Total farms	*	*	0		*	*	*	*	*	*	*	*	*	*	0	
Value of sales grains, oilseeds, dry beans and dry peas , \$50,000 or more (farms)	*	*	0		*	*	*	*	*	*	*	*	*	*	0	
Value of sales vegetables, melons, potatoes and sweetpotatoes , Total farms	*	*	0		*	*	*	*	*	*	*	*	*	*	0	
Value of sales vegetables, melons, potatoes and sweetpotatoes , \$50,000 or more (farms)	*	*	0		*	*	*	*	*	*	*	*	*	0.09625	0	
Value of sales fruits, tree nuts, and berries , Total farms	*	*	0		*	*	*	2.5	2.4825	*	*	*	*	1.0962 *	6	
Value of sales nursery, greenhouse, floriculture and sod , Total farms	0.0399 *	0 *	0 *		*	*	*	*	*	*	*	*	*	*	0	
Value of sales nursery, greenhouse, floriculture and sod , \$50,000 or more (farms)	*	*	0		*	*	*	*	*	*	*	*	*	*	0	
Value of sales other crops and hay , Total farms	0.2223	50.25	0 *	*		5.5	50.9184	10	4.965		6.5	60.5669	3.1668	0.51975	193	
Value of all livestock, poultry and their products sold , Total farms	0.9861	178.5	0	16	45	34	259.584	63.5	35.49975	6	27	231.3457	28.9884	3.86925	930	
Value of all livestock, poultry and their products sold , Less than \$50,000 (farms)	0.8322	135.75	0	14	29	18.75	161.7408	52.5	30.03825	6	22	153.8995	22.8984	2.90675	650	
Value of all livestock, poultry and their products sold , \$50,000 to \$249,999 (farms)	0.057	14.25	0		5	4.5	30.9504	4 *	*		3	25.8154	1.9488	0.231	90	
Value of all livestock, poultry and their products sold , \$250,000 or more (farms)	0.0969	28.5	0 *		11	10.75	66.8928	7	4.4685	*		51.6308	4.1412	0.7315	185	
Value of sales hogs and pigs , Total farms	0.0399 *	0 *	0 *		*	*	*	1.4895	*			4.9645 *	*	*	6	
Value of sales milk and other dairy products from cows , Total farms	*	4.5	0		*	*	6.9888	*	*			10.9219 *	*	*	22	
Value of sales milk and other dairy products from cows , \$50,000 or more (farms)	*	3.75	0		*	*	5.9904	*	*			9.929 *	*	*	20	
Value of sales cattle and calves , Total farms	0.7923	144.75	0	13	40	26.75	196.6848	45.5	28.797	6	22.5	178.722	25.3344	3.0415	732	
Value of sales cattle and calves , \$50,000 or more (farms)	0.0285	15	0		*		1.75	13.9776 *	*		2.5	12.9077	0.609 *	*	47	
Value of sales sheep, goats and their products , Total farms	0.0342	6	0 *		*		1.5	13.9776 *	1.73775	*		1.0962	0.13475	*	24	
Value of sales horses, ponies, mules, burros and donkeys , Total farms	0.1083	14.25	0 *	*			1.25	13.9776	4.5	2.979	*	16.8793	2.0706	0.51975	57	
Value of sales poultry and eggs , Total farms	0.1482	32.25	0 *		12	13.25	85.8624	10.5	5.958		2.5	67.5172	5.9682	0.94325	237	
Value of sales poultry and eggs , \$50,000 or more (farms)	0.114	27	0 *		12	13.25	85.8624	9.5	4.965		2.5	61.5598	5.481	0.8855	223	
Value of sales other animals and other animal products , Total farms	0.0342	0	0				5.5	*	*	*	*	*	*	0.09625	6	
Farms by tenure , Full owners	1.0203	168	0	18	44	29.75	213.6576	58	38.2305	11	28.5	229.3599	26.0652	3.63825	869	
Farms by tenure , Part owners	0.2337	67.5	0 *		15	9.75	78.8736	20	9.68175		7.5	56.5953	8.526	1.001	275	
Farms by tenure , Tenants	0.0342	13.5	0	*			16.9728	4.5	1.24125	*		13.9006	1.9488 *	*	52	
, Farms with one operator	0.7923	136.5	0	14	35	22.25	175.7184	55.5	28.05225	6	24.5	176.7362	21.924	2.849	700	
, Farms with multiple operators	0.4959	112.5	0	8	27	18	133.7856	27	21.10125	5	13	123.1196	14.616	1.86725	505	
, Farms with women operators	0.4845	112.5	0	7	26	18.75	151.7568	35.5	22.09425	5	18	124.1125	14.2506	2.002	537	
, Farms with principal operator living on the farm operated	1.1799	222	0	22	57	36.75	287.5392	71	39.47175	9	31	261.1327	28.1358	3.94625	1,070	
, Farms with principal operator reporting primary occupation as farming	0.7695	130.5	0	10	38	25.25	185.7024	41.5	25.56975 *		22	163.8285	20.097	2.387	666	
, Farms with principal operator reporting working off the farm for 200 days or more	0.5985	114	0	11	31	19.25	137.7792	41	22.3425	8	16	139.006	17.2956	1.848	559	
, Farms with farm-related sources of income	0.1881	33.75	0 *		10	5.25	38.9376	10	4.965		4	40.7089	4.5066	0.51975	153	
, Farms with production contracts	0.1254	27.75	0 *		12	13	88.8576	9.5	5.4615		2.5	59.574	5.6028	0.86625	225	
, Farms with direct sales	0.0855	6.75	0 *	*			4.992	4	2.4825		3.5	6.9503	1.3398	0.13475	30	
, Farms with grain storage capacity	*	3.75	0		*		7.9872	*	*			*	*	*	12	
Payments received from Federal Farm Programs , Total farms	*	10.5	0 *		6	1.75	29.952	3	1.73775		3	14.8935	0.609 *	*	71	
Payments received from Federal Farm Programs , Less than \$50,000 (farms)	*	10.5	0 *		6	1.75	29.952	3	1.73775		3	14.8935	0.609 *	*	71	
Cropland harvested , Total farms	0.7638	156.75	0	12	40	20.75	203.6736	38	24.57675 *		21.5	201.5587	19.6098	2.32925	742	
Cropland harvested , 1 to 49 acres (farms)	0.4902	96	0	7	26	13	127.7952	24.5	19.61175 *		14	128.0841	15.3468	1.5015	473	
Cropland harvested , 50 to 499 acres (farms)	0.2736	58.5	0	5	14	7.5	74.88	13	4.965		7.5	70.4959	4.0194	0.8085	261	
Cropland harvested , 500 acres or more (farms)	*	*	0		*	*	*	*	*			*	*	*	0	
, Cropland used for pasture or grazing, total farms	0.5358	112.5	0	9	28	18.5	155.7504	31	16.881 *		17	137.0202	16.443	1.925	545	
, Cropland idle or used for cover crops or soil-improvement but NOT harvested and NOT pastured or grazed, total farms	0.057	6.75	0			1.75	16.9728	4	1.73775	*		15.8864	1.5834	0.13475	49	
, Cropland on which all crops failed or were abandoned, total farms	*	*	0			1.5 *	*	*	*			*	*	*	2	
, Cropland in cultivated summer fallow, total farms	*	*	0		*	*	*	*	*			*	*	*	0	
, Total woodland, total farms	0.5472	91.5	0 *		21	23.75	152.7552	32	26.3145	8	17	146.9492	14.8596	1.848	537	
Permanent pasture and rangeland , Total farms	0.6555	120	0	11	28	17	148.7616	37	23.832	6	20.5	146.9492	18.5136	2.75275	581	
Permanent pasture and rangeland , 100 acres or more (farms)	0.0855	18	0 *		5	4.25	23.9616	4.5	2.23425 *		3	21.8438	1.9488	0.4235	85	
All other land , Total farms	0.6498	114	0	12	34	19.25	169.728	35.5	19.86 *		19.5	149.9279	19.2444	2.079	596	
All other land , 100 acres or more (farms)	*	*	0 *		*	*	*	*	*			*	*	*	0	
Land under Conservation Reserve or Wetlands Reserve Programs , Total farms		0													0	
, Cattle and calves inventory, total farms	0.9405	166.5	0	14	52	30.5	233.6256	54	34.2585	10	24.5	206.5232	28.7448	3.44575	859	
, Beef cow inventory, total farms	0.8379	148.5	0	12	44	27.25	201.6768	46.5	29.2935	8	22.5	182.6936	26.3088	3.003	753	
, Milk cow inventory, total farms	*	4.5	0		*		8.9856	*	*			13.9006	0.609	*	28	
, Cattle and calves sold, total farms	0.7923	144.75	0	13	40	26.75	196.6848	45.5	28.797	6	22.5	178.722	25.3344	3.0415	732	
, Hogs and pigs inventory, total farms	0.0513 *	0 *	0 *		*	*	*	1.24125	*			*	*	0.09625	1	
, Hogs and pigs sold, total farms	0.0399 *	0 *	0 *		*	*	*	1.4895	*			4.9645 *	*	*	6	
, Sheep and lambs inventory, total farms	*	6	0			1.25	9.984 *	1.4895	*			5.9574	0.8526 *	*	26	
, Layers 20 weeks old and older inventory, total farms	0.0684	9.75	0 *	*		2	16.9728	3	3.72375	*		20.8509	1.0962	0.1155	58	
, Horses and ponies of all ages inventory, total farms	0.4332	79.5	0	7	18	9.75	85.8624	22.5	16.881 *		11	85.3894	10.353	1.55925	348	
, Horses and ponies of all ages sold, total farms	0.1026	14.25	0 *	*		1.25	13.9776	4.5	2.979	*		16.8793	1.5834	0.51975	56	
, Broilers and other meat type chickens sold, total farms	0.0912	21	0 *</													

Table BA: Arkansas study area 2002 zip code census data showing county zip code and study:

Zip Code	72702	72703	72704	72717	72728	72729	72730	72734	72741	Washington County											Washington County	Study Area
Percent in County	100.00%	98.99%	99.43%	100.00%	100.00%	100.00%	100.00%	0.14%	100.00%	100.00%	100.00%	99.87%	0.40%	0.71%	87.82%	92.30%	100.00%	100.00%	100.00%	100.00%	100.00%	
Percent Relevant to Study Area	100.00%	25.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	25.00%	100.00%	100.00%	25.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
Farms by size , All farms	19	41.823275	224.7118	101	6	27	116	0.434 *		299	11	323.5788	0.198	2.1442	263.46	56.53375	20	10	89	15	1,626	
Farms by size , 1 to 49 acres	6	17.32325	112.3559	36 *			67	0.1764 *		111 *		130.8297	0.103	0.8591	137.8774	27.69	5	5	26	8	691	
Farms by size , 50 to 999 acres	13	24.25255	110.3673	62	5	23	48	0.252 *		188	7	190.7517	0.093	1.2496	121.1916	27.45925	12	5	62	7	908	
Farms by size , 1,000 acres or more	*		*			*	*			*		*		0.0355	4.391	1.3845 *		*			6	
Value of all agricultural products sold , Total farms	19	41.823275	224.7118	101	6	27	116	0.434 *		299	11	323.5788	0.198	2.1442	263.46	56.53375	20	10	89	15	1,626	
Value of all agricultural products sold , Less than \$50,000 (farms)	16	37.368725	195.8771	80	6	18	89	0.2954 *		216	11	273.6438	0.175	1.562	217.7936	44.304	13	10	66	12	1,308	
Value of all agricultural products sold , \$50,000 to \$249,999 (farms)	*	1.237375	11.9316	6	*		9	0.042		38		25.9662	0.005	0.213	15.8076	3.2305 *			13 *		124	
Value of all agricultural products sold , \$250,000 or more (farms)	*	3.217175	16.9031	15			6	18	0.0966	45		23.9868	0.018	0.3692	29.8588	8.99925	5		10 *		182	
Value of all crops sold, including nursery and greenhouse , Total farms	8	8.41415	50.7093	11 *			5	24	0.0756 *	54		47.9376	0.034	0.4899	33.3716	7.8455 *			13 *		264	
Value of all crops sold, including nursery and greenhouse , Less than \$50,000 (farms)	6	8.41415	48.7207	11 *			5	24	0.0728 *	50		46.9389	0.033	0.4686	31.6152	7.15325 *			13 *		252	
Value of all crops sold, including nursery and greenhouse , \$50,000 to \$249,999 (farms)										*		*	*	*	*	*			*		471	
Value of sales grains, oilseeds, dry beans and dry peas , Total farms		1.237375 *										*	*	*	*	*			*		0	
Value of sales grains, oilseeds, dry beans and dry peas , \$50,000 or more (farms)		*										*	*	*	*	*			*		1	
Value of sales vegetables, melons, potatoes and sweetpotatoes , Total farms		*				*	*	*	*	*	*	*	*	*	*	*			*		0	
Value of sales vegetables, melons, potatoes and sweetpotatoes , \$50,000 or more (farms)		*				*	*	*	*	*	*	*	*	*	*	*			*		1	
Value of sales fruits, tree nuts, and berries , Total farms		1.48485 *				*	*	*	*	*	*	*	0.01 *		7.9038 *				*		9	
Value of sales nursery, greenhouse, floriculture and sod , Total farms	*	*	6.9601		*				*	*	*	*	*	*	*	*		*	*	*	7	
Value of sales nursery, greenhouse, floriculture and sod , \$50,000 or more (farms)	*	*			*				*	*	*	*	*	*	*	*		*	*	*	15	
Value of sales other crops and hay , Total farms	6	6.186875	38.7777	10 *	*		21	0.0714		49		44.9415	0.02	0.4331	22.8332	6.23025 *			11 *		216	
Value of all livestock, poultry and their products sold , Total farms	8	26.974775	172.0139	84	5	21	84	0.364 *		229	9	251.6724	0.143	1.6543	209.0116	46.38075	17	10	83	11	1,269	
Value of all livestock, poultry and their products sold , Less than \$50,000 (farms)	7	22.520225	145.1678	63	5	12	57	0.2268 *		149	9	203.7348	0.121	1.1005	165.1016	34.84325	10	10	61	8	964	
Value of all livestock, poultry and their products sold , \$50,000 to \$249,999 (farms)		1.237375	9.943	6	*		9	0.0434		35		23.9688 *	0.1846	14.0512	2.769 *				13 *		115	
Value of all livestock, poultry and their products sold , \$250,000 or more (farms)	*	3.217175	16.9031	15			6	18	0.0938	45		23.9688	0.018	0.3692	29.8588	8.7685	5		9 *		181	
Value of sales hogs and pigs , Total farms		*	6.9601							*		10.9857	0.006	0.0355 *		*	*	*	*		18	
Value of sales milk and other dairy products from cows , Total farms		*	*	*	*			0.0098		10		*	*	0.0781 *					8		18	
Value of sales milk and other dairy products from cows , \$50,000 or more (farms)		*	*	*	*			0.0084		10		*	*	0.071 *					8		18	
Value of sales cattle and calves , Total farms	6	21.530325	138.2077	77 *	*	20	70	0.2758 *		196	9	215.7192	0.116	1.278	182.6656	36.4585	13	6	77	6	1,076	
Value of sales cattle and calves , \$50,000 or more (farms)	*	*	4.9715	5	*		5	0.0196		19		8.9883	0.0923	4.391 *		*	*	*			47	
Value of sales sheep, goats and their products , Total farms		1.237375	5.9658	11			*	0.0196		7		12.9831	0.007 *		7.9038	1.61525			*		48	
Value of sales horses, ponies, mules, burros and donkeys , Total farms		4.207075	18.8917	*	*		10	0.0196		13		20.9727	0.012	0.1207	14.9294	6.23025 *			7 *		95	
Value of sales poultry and eggs , Total farms		3.9596	25.8518	19			6	21	0.1204	61		36.9519	0.024	0.4828	43.0318	11.30675 *		*			242	
Value of sales poultry and eggs , \$50,000 or more (farms)		3.712125	19.886	16			6	21	0.1204	55		36.9519	0.02	0.4402	39.519	10.6145 *			12 *		221	
Value of sales other animals and other animal products , Total farms	*	*	5.9658 *					*	*			*	*	*	*	*			*		7	
Farms by tenure , Full owners	17	32.17175	177.9797	83	6	21	75	0.2996 *		231	7	258.6633	0.154	1.6401	187.9348	43.61175	12	10	69	10	1,243	
Farms by tenure , Part owners	*	6.43435	40.7663	17	*		31	0.1106 *		60 *		48.9363	0.039	0.4047	61.474	11.999	7		17 *		302	
Farms by tenure , Tenants		3.217175	5.9658 *		*		10	0.0238		8		15.9792	0.005	0.0994	14.0512 *		*	*	*		57	
, Farms with one operator	17	26.23235	138.2077	52 *	*	10	66	0.2464 *		173	9	185.7582	0.113	1.2638	158.076	34.151	13 *		57	10	951	
, Farms with multiple operators		15.590925	86.5041	49	5	17	50	0.1876 *		126 *		137.8206	0.085	0.8804	105.384	22.38275	7	7	32	5	667	
, Farms with women operators		18.31315	84.5155	57	5	16	45	0.2128 *		133 *		162.7881	0.089	0.8875	102.7494	23.998	6	7	34	8	705	
, Farms with principal operator living on the farm operated	15	27.7172	205.8201	93	6	26	88	0.4032 *		283	9	288.6243	0.159	1.8673	202.8642	47.30375	14	10	83	13	1,415	
, Farms with principal operator reporting primary occupation as farming	5	20.045475	134.2305	66 *	*	19	57	0.2604 *		174	9	176.7699	0.103	1.1715	144.903	28.613	10 *		63	6	915	
, Farms with principal operator reporting working off the farm for 200 days or more	14	18.8081	104.4015	40 *		6	69	0.1932 *		111 *		151.8024	0.09	0.994	124.7044	22.152	9	6	30	7	715	
, Farms with farm-related sources of income		5.196975	32.8119	19	*		11	0.0546 *		43 *		36.9519	0.02	0.2911	32.4934	6.23025 *			12 *		199	
, Farms with production contracts		3.9596	21.8746	17			6	22	0.1246	52		37.9506	0.022	0.426	40.3972	10.38375 *		*	14 *		226	
, Farms with direct sales		3.712125	14.9145 *		*		*	0.007 *		11		7.9896	0.01	0.0497	9.6602	1.61525					49	
, Farms with grain storage capacity		*	*					0.0112	*		*	*	*	*	*	*					12	
Payments received from Federal Farm Programs , Total farms		*	*	5 *	*		7	0.042		11		6.9909	0.007	0.1065	4.391 *	*	*	*	*		35	
Payments received from Federal Farm Programs , Less than \$50,000 (farms)		*	*	5 *	*		7	0.042		11		6.9909	0.007	0.1065	4.391 *	*	*	*	*		35	
Cropland harvested , Total farms	15	20.540425	133.2362	70 *	*	21	73	0.2856 *		208 *		191.7504	0.099	1.4413	141.3902	27.92075	12	5	63	8	992	
Cropland harvested , 1 to 49 acres (farms)	8	13.116175	85.5098	40 *	*	11	53	0.1792 *		128 *		124.8375	0.079	0.9159	110.6532	17.9985	6	5	31	5	640	
Cropland harvested , 50 to 499 acres (farms)	7	7.176775	47.7264	29 *	*	10	19	0.105 *		80 *		66.9129	0.02	0.5041	28.9806	9.6915	6		32 *		344	
Cropland harvested , 500 acres or more (farms)		*	*		*		*	*	*			*	*	*	*	*					0	
, Cropland used for pasture or grazing, total farms	*	18.065675	93.4642	54	5	15	37	0.2184 *		150 *		150.8037	0.068	0.9798	118.557	23.075	13	5	40	6	730	
, Cropland idle or used for cover crops or soil-improvement but NOT harvested and NOT pastured or grazed, total farms		*	9.943 *		*		6	0.0238		24		6.9909	0.007	0.1136	11.4161	1.61525 *		*			60	
, Cropland on which all crops failed or were abandoned, total farms		1.237375 *			*		*	*	*	*	*	*	*	*	*	*					6	
, Cropland in cultivated summer fallow, total farms	*	*	*		*		*	*	*	*	*	*	*	*	*	*					0	

TableBO: Oklahoma study area 2002 zip code census data showing county zip code and study area data

Zip Code	Adair County							Adair County	Cherokee County											Cherokee County	
	74338	74347	74457	74931	74960	74964	74965		74347	74359	74427	74451	74464	74465	74471	74931	74960	74962	74964		
	0.32%	0.30%	100.00%	34.55%	99.59%	87.16%	100.00%		Study Area	2.03%	29.58%	100.00%	100.00%	99.98%	100.00%	100.00%	61.26%	0.41%	0.13%		0.00
Percent Relevant to Study Area	50.00%	100.00%	100.00%	50.00%	50.00%	100.00%	100.00%	Total	100.00%	100.00%	100.00%	100.00%	50.00%	100.00%	100.00%	50.00%	50.00%	25.00%	1.00	Total	
Farms by size , All farms	0.52	0.26	45.00	11.06	289.81	108.08	311.00	766	1.73	3.55	11.00	68.00	265.95	56.00	72.00	19.60	1.19	0.06	0.42	500	
Farms by size , 1 to 49 acres	0.17	0.05	5.00	2.07	82.16	34.86	91.00	215	0.35 *			22.00	81.98	23.00	25.00	3.68	0.34	0.01	0.14	156	
Farms by size , 50 to 999 acres	0.34	0.20	36.00	8.64	200.18	72.34	211.00	529	1.34	2.96	10.00	43.00	176.96	29.00	45.00	15.32	0.82	0.05	0.28	325	
Farms by size , 1,000 acres or more					7.47 *		9.00	16					7.00 *				0.03	0.00 *		7	
Value of all agricultural products sold , Total farms	0.52	0.26	45.00	11.06	289.81	108.08	311.00	766	1.73	3.55	11.00	68.00	265.95	56.00	72.00	19.60	1.19	0.06	0.42	500	
Value of all agricultural products sold , Less than \$50,000 (farms)	0.39	0.21	41.00	9.67	251.46	87.16	225.00	615	1.40	2.96	10.00	60.00	241.95	52.00	67.00	17.15	1.04	0.06	0.34	454	
Value of all agricultural products sold , \$50,000 to \$249,999 (farms)	0.07	0.02 *			28.38	12.20	54.00	95	0.16 *			6.00	12.00 *				0.12	0.00	0.05	18	
Value of all agricultural products sold , \$250,000 or more (farms)	0.05	0.02 *			9.96	8.72	32.00	51	0.16 *				12.00				0.04 *		0.03	12	
Value of all crops sold, including nursery and greenhouse , Total farms	0.06	0.05	7.00	1.21	36.85	19.18	43.00	107	0.32 *			11.00	63.49	15.00	11.00	2.14	0.15	0.01	0.07	103	
Value of all crops sold, including nursery and greenhouse , Less than \$50,000 (farms)	0.06	0.05	6.00	1.21	32.86	19.18	43.00	102	0.32 *			9.00	59.49	15.00	9.00	2.14	0.14	0.01	0.07	95	
Value of all crops sold, including nursery and greenhouse , \$50,000 to \$249,999 (farms)					3.98			4									0.02	0.00		0	
Value of sales grains, oilseeds, dry beans and dry peas , Total farms								0										0.00		0	
Value of sales grains, oilseeds, dry beans and dry peas , \$50,000 or more (farms)								0										0.00		0	
Value of sales vegetables, melons, potatoes and sweetpotatoes , Total farms					3.49 *			3									0.01 *			0	
Value of sales vegetables, melons, potatoes and sweetpotatoes , \$50,000 or more (farms)					2.49			2									0.01 *			0	
Value of sales fruits, tree nuts, and berries , Total farms					3.98			4					10.50	5.00 *			0.02 *			16	
Value of sales nursery, greenhouse, floriculture and sod , Total farms								0					5.00							5	
Value of sales nursery, greenhouse, floriculture and sod , \$50,000 or more (farms)								0					3.00							3	
Value of sales other crops and hay , Total farms	0.06	0.05	6.00	1.21	31.37	18.30	43.00	100	0.32 *			9.00	50.49	12.00	7.00	2.14	0.13	0.01	0.07	81	
Value of all livestock, poultry and their products sold , Total farms	0.42	0.18	37.00	8.46	204.66	71.47	259.00	581	1.22	2.66	5.00	54.00	191.96	35.00	53.00	15.01	0.84	0.04	0.28	359	
Value of all livestock, poultry and their products sold , Less than \$50,000 (farms)	0.30	0.13	34.00	7.08	173.78	50.55	176.00	442	0.89	2.07 *		48.00	171.97	31.00	50.00	12.56	0.72	0.04	0.20	317	
Value of all livestock, poultry and their products sold , \$50,000 to \$249,999 (farms)	0.07	0.02 *			20.91	12.20	51.00	84	0.16 *			6.00	10.00 *				0.09 *		0.05	16	
Value of all livestock, poultry and their products sold , \$250,000 or more (farms)	0.05	0.02 *			9.96	8.72	32.00	51	0.16 *				10.00				0.04 *		0.03	10	
Value of sales hogs and pigs , Total farms	0.03				5.98	4.36	6.00	16				6.00	7.50				0.02	0.00	0.02	14	
Value of sales milk and other dairy products from cows , Total farms	0.04				13.94	9.59	54.00	78					8.00 *				0.06		0.04	8	
Value of sales milk and other dairy products from cows , \$50,000 or more (farms)	0.03				12.45	8.72	51.00	72					6.50 *				0.05		0.03	7	
Value of sales cattle and calves , Total farms	0.36	0.15	29.00	6.39	181.25	60.14	237.00	514	1.04	2.66	5.00	41.00	167.47	32.00	45.00	11.33	0.75	0.04	0.23	307	
Value of sales cattle and calves , \$50,000 or more (farms)	0.03	0.02 *			9.96 *		11.00	21	0.16 *				9.00 *				0.04 *			9	
Value of sales sheep, goats and their products , Total farms	0.01 *		6.00	1.38	13.44 *		5.00	26				6.00	10.50 *			7.00	2.45	0.06	0.00 *	26	
Value of sales horses, ponies, mules, burros and donkeys , Total farms	0.04	0.03 *			1.55	18.92	5.23	23.00	49	0.22 *			6.00	22.50	5.00	7.00	2.76	0.08	0.00	0.02	44
Value of sales poultry and eggs , Total farms	0.08	0.02			21.91	9.59	31.00	64	0.12			5.00	18.50 *			5.00	1.84	0.09 *		0.04	31
Value of sales poultry and eggs , \$50,000 or more (farms)	0.07	0.02			13.94	6.97	28.00	50	0.12				7.00				1.53	0.06 *		0.03	9
Value of sales other animals and other animal products , Total farms					2.99			3									0.01 *			0	
Farms by tenure , Full owners	0.37	0.20	36.00	8.29	204.66	74.96	215.00	539	1.38	1.77	5.00	48.00	191.96	37.00	48.00	14.70	0.84	0.04	0.29	349	
Farms by tenure , Part owners	0.13	0.05	7.00	2.59	74.19	32.25	89.00	205	0.35	1.77	6.00	18.00	65.49	17.00	20.00	4.59	0.31	0.02	0.13	134	
Farms by tenure , Tenants	0.01				10.95 *		7.00	18					8.50 *				0.05	0.00 *		9	
, Farms with one operator	0.28	0.16	34.00	6.91	174.28	53.17	200.00	469	1.06	2.07	6.00	33.00	141.97	29.00	39.00	12.25	0.72	0.04	0.21	265	
, Farms with multiple operators	0.23	0.10	11.00	4.15	115.52	54.91	111.00	297	0.67	1.48	5.00	35.00	123.98	27.00	33.00	7.35	0.48	0.02	0.21	234	
, Farms with women operators	0.24	0.09	9.00	4.66	118.51	58.40	125.00	316	0.63	1.48	5.00	30.00	127.47	28.00	29.00	8.27	0.49	0.02	0.23	231	
, Farms with principal operator living on the farm operated	0.49	0.23	43.00	10.19	259.43	104.59	278.00	696	1.52	2.96	11.00	57.00	240.45	45.00	64.00	18.07	1.07	0.06	0.41	442	
, Farms with principal operator reporting primary occupation as farming	0.29	0.13	30.00	6.56	155.86	50.55	185.00	428	0.89	2.96	6.00	30.00	159.97	15.00	46.00	11.64	0.64	0.04	0.20	273	
, Farms with principal operator reporting working off the farm for 200 days or more	0.22	0.11	17.00	4.66	138.93	55.78	131.00	348	0.77 *		5.00	28.00	104.98	40.00	35.00	8.27	0.57	0.03	0.22	223	
, Farms with farm-related sources of income	0.06	0.04 *			1.90	48.80	9.59	56.00	116	0.24 *		19.00	50.49	9.00	12.00	3.37	0.20	0.01	0.04	94	
, Farms with production contracts	0.07	0.02			0.86	13.94	9.59	26.00	50	0.12 *			7.00			1.53	0.06 *		0.04	9	
, Farms with direct sales					4.48 *		8.00	12				6.00	6.50				0.02 *			13	
, Farms with grain storage capacity					6.47			6					2.50 *				0.03	0.00		3	
Payments received from Federal Farm Programs , Total farms	0.08	0.06	8.00	2.25	45.81	21.79	90.00	168	0.39 *			15.00	49.49 *			14.00	3.98	0.19	0.01	0.09	83
Payments received from Federal Farm Programs , Less than \$50,000 (farms)	0.08	0.06	8.00	2.25	45.81	21.79	90.00	168	0.39 *			15.00	49.49 *			14.00	3.98	0.19	0.01	0.09	83
Cropland harvested , Total farms	0.30	0.16	25.00	6.91	159.84	54.91	191.00	438	1.08	2.37 *		28.00	144.97	34.00	40.00	12.25	0.66	0.04	0.21	264	
Cropland harvested , 1 to 49 acres (farms)	0.16	0.08	14.00	3.63	100.09	29.63	96.00	244	0.57 *			18.00	91.48	23.00	23.00	6.43	0.41	0.02	0.12	163	
Cropland harvested , 50 to 499 acres (farms)	0.13	0.08	9.00	3.28	59.26	25.28	91.00	188	0.51	1.48 *		10.00	51.99	10.00	15.00	5.82	0.24	0.02	0.10	95	
Cropland harvested , 500 acres or more (farms)								0										0.00		0	
, Cropland used for pasture or grazing, total farms	0.22	0.11	28.00	6.22	154.86	61.01	151.00	401	0.75		9.00	30.00	118.98	23.00	25.00	11.03	0.64	0.02	0.24	219	
, Cropland idle or used for cover crops or soil-improvement but NOT harvested and NOT pastured or grazed, total farms	0.02 *		5.00	1.04	17.93	6.97	19.00	50					15.00	6.00 *		1.84	0.07	0.00	0.03	23	
, Cropland on which all crops failed or were abandoned, total farms	0.02				6.47		5.00	11					5.50				0.03	0.00		6	
, Cropland in cultivated summer fallow, total farms																					

TableBO: Oklahoma study area 2002 zip code census data showing county zip code and study

Zip Code	Delaware County					Delaware County	Sequoyah County			Sequoyah County	Study Area	Total
	74338	74347	74359	74464	74964		74435	74931	74962			
Percent in County	99.68%	97.66%	70.42%	0.02%	12.50%	Study Area	89.31%	4.19%	99.87%	Study Area		
Percent Relevant to Study Area	50.00%	100.00%	100.00%	50.00%	100.00%	Total	75.00%	50.00%	25.00%	Total		
Farms by size , All farms	160.48	83.01	8.45	0.05	15.50	267	67.65	1.34	48.69	118		1,650
Farms by size , 1 to 49 acres	52.33	16.60	*	0.02	5.00	74	17.42	0.25	8.24	26		472
Farms by size , 50 to 999 acres	106.66	64.46	7.04	0.04	10.38	189	46.22	1.05	38.70	86		1,128
Farms by size , 1,000 acres or more	*	*		0.00	*	0	4.02	*	1.75	6		29
Value of all agricultural products sold , Total farms	160.48	83.01	8.45	0.05	15.50	267	67.65	1.34	48.69	118		1,650
Value of all agricultural products sold , Less than \$50,000 (farms)	121.61	67.39	7.04	0.05	12.50	209	64.30	1.17	45.94	111		1,389
Value of all agricultural products sold , \$50,000 to \$249,999 (farms)	21.93	7.81		0.00	1.75	31	*	*	2.25	2		147
Value of all agricultural products sold , \$250,000 or more (farms)	16.95	7.81	*	0.00	1.25	26	*	*		0		89
Value of all crops sold, including nursery and greenhouse , Total farms	19.44	15.63	*	0.01	2.75	38	11.39	0.15	10.74	22		271
Value of all crops sold, including nursery and greenhouse , Less than \$50,000 (farms)	19.44	15.63	*	0.01	2.75	38	9.38	0.15	9.24	19		254
Value of all crops sold, including nursery and greenhouse , \$50,000 to \$249,999 (farms)						0	*	*	1.25	1		5
Value of sales grains, oilseeds, dry beans and dry peas , Total farms			*			0	3.35		1.25	6		6
Value of sales grains, oilseeds, dry beans and dry peas , \$50,000 or more (farms)						0	*		1.25	1		1
Value of sales vegetables, melons, potatoes and sweetpotatoes , Total farms			*	*		0	*	*		0		4
Value of sales vegetables, melons, potatoes and sweetpotatoes , \$50,000 or more (farms)						0	*	*		0		3
Value of sales fruits, tree nuts, and berries , Total farms				0.00		0	*	*		0		20
Value of sales nursery, greenhouse, floriculture and sod , Total farms				0.00		0	*	*		0		5
Value of sales nursery, greenhouse, floriculture and sod , \$50,000 or more (farms)				0.00		0	*	*		0		3
Value of sales other crops and hay , Total farms	19.44	15.63	*	0.01	2.63	38	8.04	0.15	7.74	16		235
Value of all livestock, poultry and their products sold , Total farms	131.58	58.60	6.34	0.04	10.25	207	46.89	1.03	33.21	81		1,228
Value of all livestock, poultry and their products sold , Less than \$50,000 (farms)	92.70	42.97	4.93	0.03	7.25	148	45.55	0.86	31.96	78		986
Value of all livestock, poultry and their products sold , \$50,000 to \$249,999 (farms)	22.43	7.81		0.00	1.75	32	*	*		0		132
Value of all livestock, poultry and their products sold , \$250,000 or more (farms)	16.45	7.81	*	0.00	1.25	26	*	*		0		86
Value of sales hogs and pigs , Total farms	8.47	*		0.00	0.63	9	*	*	1.25	1		40
Value of sales milk and other dairy products from cows , Total farms	11.46	*		0.00	1.38	13	*	*		0		90
Value of sales milk and other dairy products from cows , \$50,000 or more (farms)	9.97	*		0.00	1.25	11	*	*		0		90
Value of sales cattle and calves , Total farms	112.64	49.81	6.34	0.03	8.63	177	44.88	0.78	30.21	76		1,074
Value of sales cattle and calves , \$50,000 or more (farms)	8.47	7.81	*	0.00	*	16	*	*		0		46
Value of sales sheep, goats and their products , Total farms	3.99	*		0.00	*	4	*	0.17	1.75	2		58
Value of sales horses, ponies, mules, burros and donkeys , Total farms	11.96	10.74	*	0.00	0.75	23	*	0.19	3.75	4		120
Value of sales poultry and eggs , Total farms	24.42	5.86		0.00	1.38	32	*	0.13	*	0		126
Value of sales poultry and eggs , \$50,000 or more (farms)	21.43	5.86		0.00	1.00	28	*	0.10	*	0		87
Value of sales other animals and other animal products , Total farms	114.13	66.41	4.23	0.04	10.75	196	45.55	1.01	27.46	74		1,158
Farms by tenure , Full owners	41.87	16.60	4.23	0.01	4.63	67	20.09	0.31	18.48	39		445
Farms by tenure , Part owners	4.49			0.00	*	4	*	*	2.75	3		34
Farms by tenure , Tenants	88.72	50.78	4.93	0.03	7.63	152	34.16	0.84	31.46	66		953
, Farms with one operator	71.77	32.23	3.52	0.02	7.88	115	33.49	0.50	17.23	51		698
, Farms with multiple operators	76.26	30.27	3.52	0.03	8.38	118	28.80	0.57	18.73	48		713
, Farms with women operators	151.51	73.25	7.04	0.05	15.00	247	58.27	1.24	44.44	104		1,488
, Farms with principal operator living on the farm operated	90.71	42.97	7.04	0.03	7.25	148	34.16	0.80	29.71	65		914
, Farms with principal operator reporting primary occupation as farming	69.78	37.11	*	0.02	8.00	115	32.82	0.57	21.22	55		740
, Farms with principal operator reporting working off the farm for 200 days or more	17.44	11.72	*	0.01	1.38	31	3.35	0.23	7.74	11		253
, Farms with farm-related sources of income	22.93	5.86		0.00	1.38	30	*	0.10	*	0		89
, Farms with production contracts	*	*		0.00	*	0	*	*	*	0		25
, Farms with direct sales		*		0.00		0	*	*		2		12
, Farms with grain storage capacity	25.42	18.56	*	0.01	3.13	47	12.06	0.27	8.24	21		319
Payments received from Federal Farm Programs , Total farms	25.42	18.56	*	0.01	3.13	47	12.06	0.27	8.24	21		319
Payments received from Federal Farm Programs , Less than \$50,000 (farms)	92.20	51.76	5.63	0.03	7.88	158	34.16	0.84	32.21	67		926
Cropland harvested , Total farms	50.34	27.34	*	0.02	4.25	82	13.40	0.44	16.23	30		519
Cropland harvested , 1 to 49 acres (farms)	41.87	24.42	3.52	0.01	3.63	73	18.76	0.40	14.73	34		391
Cropland harvested , 50 to 499 acres (farms)						0	*	*	1.25	1		1
Cropland harvested , 500 acres or more (farms)	68.28	36.13		0.02	8.75	113	31.48	0.75	18.73	51		784
, Cropland used for pasture or grazing, total farms	5.98	*		0.00	1.00	7	6.03	0.13	2.00	8		88
, Cropland idle or used for cover crops or soil-improvement but NOT harvested and NOT pastured or grazed, total farms	5.48			0.00		5	*	*	1.75	2		24
, Cropland in cultivated summer fallow, total farms			*			0	*	*		0		4
, Total woodland, total farms	77.75	41.02	*	0.03	6.38	125	29.47	0.90	22.97	53		822
Permanent pasture and rangeland , Total farms	82.24	43.95	7.04	0.03	6.38	140	26.12	0.61	24.47	51		846
Permanent pasture and rangeland , 100 acres or more (farms)	16.45	25.39	3.52	0.01	1.50	47	6.70	0.21	10.49	17		248
All other land , Total farms	83.23	41.99	4.23	0.03	7.25	137	24.11	0.59	19.72	44		751
All other land , 100 acres or more (farms)	3.49			0.00	0.63	4	*	*		0		17
Land under Conservation Reserve or Wetlands Reserve Programs , Total farms				0.00		0	*	*		0		14
, Cattle and calves inventory, total farms	126.59	58.60	6.34	0.04	11.75	203	54.93	1.01	34.95	91		1,276
, Beef cow inventory, total farms	108.65	47.85	4.93	0.03	10.63	172	50.24	0.80	30.21	81		1,070
, Milk cow inventory, total farms	12.96	*		0.00	1.38	14	*	*	*	0		106
, Cattle and calves sold, total farms	112.64	49.81	6.34	0.03	8.63	177	44.88	0.78	30.21	76		1,074
, Hogs and pigs inventory, total farms	8.47	*		0.00	*	8	*	*	1.75	2		38
, Hogs and pigs sold, total farms	8.47	*		0.00	0.63	9	*	*	1.25	1		40
, Sheep and lambs inventory, total farms	*	*		0.00	*	0	*	0.13	*	0		27
, Layers 20 weeks old and older inventory, total farms	12.46	*		0.00	0.88	13	4.69	0.15	2.25	7		87
, Horses and ponies of all ages inventory, total farms	54.82	36.13	4.23	0.02	5.63	101	18.76	0.59	20.97	40		581
, Horses and ponies of all ages sold, total farms	11.96	10.74	*	0.00	0.75	23	*	0.19	3.75	4		118
, Broilers and other meat type chickens sold, total farms	13.96	*		0.00	*	14	*	0.10	*	0		50
, Turkeys sold, total farms	*	*		0.00	*	0	*	*	*	0		3
Corn for grain , Total farms			*			0	*	*	1.25	1		1
All wheat for grain , Total farms			*			0	*	*	1.25	1		1
Soybeans for beans , Total farms			*			0	3.35		2.25	6		6
Soybeans for beans , 250 acres or more (farms)						0	3.35		1.75	5		5
, Dry edible beans (excluding limas), total farms						0	*	*		0		0
Forage - Land used for all hay and all haylage, grass silage, and greenchop , Total farms	92.20	51.76	5.63	0.03	7.75	157	30.81	0.84	29.96	62		899
Forage - Land used for all hay and all haylage, grass silage, and greenchop , 1 to 49 acres (farms)	50.84	27.34	*	0.02	4.13	82	13.40	0.44	16.23	30		506
Forage - Land used for all hay and all haylage, grass silage, and greenchop , 50 to 249 acres (farms)	39.87	22.46	3.52	0.01	3.63	69	17.42	0.38	13.23	31		361
Forage - Land used for all hay and all haylage, grass silage, and greenchop , 250 acres or more (farms)	*	*		0.00		0	*	*	*	0		18
Vegetables and melons for sale , Total farms			*	*		0	*	*	*	0		4
Land in orchards , Total farms	*	*		0.00		0	*	*	*	0		14
Land in orchards , 0.1 to 14.9 acres (farms)	*	*		0.00		0	*	*	*	0		11
Land in orchards , 15.0 to 99.9 acres (farms)	*	*		0.00		0	*	*	*	0		3
, Berries, total farms				0.00		0	*	*	*	0		7